

## ABSTRACT

METHOD OF IDENTIFYING AN EXTREME INTERACTION  
PITCH REGION, METHODS OF DESIGNING MASK  
PATTERNS AND MANUFACTURING MASKS, DEVICE  
MANUFACTURING METHODS AND COMPUTER PROGRAMS

Optical proximity effects (OPEs) are a well-known phenomenon in  
photolithography. OPEs result from the structural interaction between the main feature  
and neighboring features. It has been determined by the present inventors that such  
structural interactions not only affect the critical dimension of the main feature at the  
image plane, but also the process latitude of the main feature. Moreover, it has been  
determined that the variation of the critical dimension as well as the process latitude of  
the main feature is a direct consequence of light field interference between the main  
feature and the neighboring features. Depending on the phase of the field produced by the  
neighboring features, the main feature critical dimension and process latitude can be  
improved by constructive light field interference, or degraded by destructive light field  
interference. The phase of the field produced by the neighboring features is dependent on  
the pitch as well as the illumination angle. For a given illumination, the forbidden pitch  
region is the location where the field produced by the neighboring features interferes with  
the field of the main feature destructively. The present invention provides a method for  
determining and eliminating the forbidden pitch region for any feature size and  
illumination condition. Moreover, it provides a method for performing illumination  
design in order to suppress the forbidden pitch phenomena, and for optimal placement of  
scattering bar assist features.